CONFERENCE ON DISARMAMENT

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PROGRESS REPORT TO THE CONFERENCE ON DISARMAMENT ON THE FORTY-FIRST SESSION OF THE AD HOC GROUP OF SCIENTIFIC EXPERTS TO CONSIDER INTERNATIONAL COOPERATIVE MEASURES TO DETECT AND IDENTIFY SEISMIC EVENTS

1. The Ad Hoc Group of Scientific Experts to Consider International Cooperative Measures to Detect and Identify Seismic Events, initially established in pursuance of the decision taken by the Conference of the Committee on Disarmament on 22 July 1976, held its forty-first formal session from 7 to 18 August 1995, in the Palais des Nations, Geneva, under the Chairmanship of Dr. Ola Dahlman of Sweden. This was the thirty-third session of the Group, convened under its new mandate by the decision of the Committee on Disarmament at its 48th meeting on 7 August 1979.

2. The Ad Hoc Group is open to all Member States of the Conference on Disarmament. It is also open on a standing basis to all non-Member States which have been invited upon their request by the Conference on Disarmament to participate in its work. Accordingly, scientific experts and representatives of the following Member States of the Conference on Disarmament participated in the session: Argentina, Australia, Belgium, Brazil, Bulgaria, Canada, China, Egypt, France, Germany, Hungary, India, Iran (Islamic Republic of), Italy, Japan, Mongolia, the Netherlands, Pakistan, Romania, the Russian Federation, Sweden, the United Kingdom of Great Britain and Northern Ireland and the United States of America.

3. Scientific experts and representatives from the following non-Member States of the Conference on Disarmament participated in the session: Austria, the Czech Republic, Denmark, Finland, Israel, the Republic of Korea, Norway, South Africa, Spain, Switzerland and Ukraine.

4. During the session 63 papers containing information on national investigations related to the work of the Group were presented by participating experts. These working papers not only described the individual operational aspects of the participation in GSETT-3 but also contained important information related to the evaluation of the experiment. In addition, substantial technical and scientific material was presented by the three GSETT-3 Working Groups on Planning, Operations and Evaluation.

5. The Group reviewed results from its Third Technical Test, GSETT-3, which successfully began full-scale operations on 1 January 1995. As stated in CD/1254, the primary objectives of GSETT-3 are to:

- Develop and test new concepts for an experimental International Seismic Monitoring System (ISMS), building upon previous experience;

- Provide a practical basis upon which to furnish the Conference on Disarmament with timely technical information;

- Develop an experimental system that can evolve and adapt to support future requirements that may be specified for an International Seismic Monitoring System.

The concepts for an experimental seismic monitoring system to be tested during GSETT-3 include: a single centralized International Data Centre (IDC), a specifically designed high-quality seismographic network consisting of about 50 primary (Alpha) stations and 100-150 auxiliary (Beta) stations, National Data Centres (NDCs) in participating countries, and a modern communications system to support data exchange among these elements.

The IDC has been in operation since 1 January 1995, with the processing and analysis methods at the IDC being continuously improved as experience is gained. As of this date, 37 primary and 75 auxiliary stations are participating in the experiment. This participation is detailed in the tables and figures attached to this Report.

The global station coverage is presently uneven, and many of the conclusions drawn are based on observational data from selected regions only. These are regions with station coverage corresponding to the original GSETT-3 plan, and the observational results are supplemented by theoretical modelling and are continuously evaluated. Although the number of stations currently participating falls short of that envisaged when the experiment was planned, there is wide enough participation to begin to draw practical conclusions regarding several aspects of the ISMS concept. Some of the most important conclusions are summarized below, with additional details provided in Annex 1.

6. The GSETT-3 has demonstrated the following technical results:

(a) The overall concept of a system based on a single IDC, NDCs in participating States and a two-tiered network of primary and auxiliary stations is an efficient concept for an International Seismological Monitoring System.

(b) A single International Data Centre, of the structure and size established during GSETT-3, can acquire and archive the volume of seismic data that is anticipated from the IMS to be established under a CTBT. It has been shown that a single IDC can routinely analyze this large volume of data in a timely manner and produce and distribute a set of defined products that are usable and useful for seismological monitoring and system evaluation. Additional work is needed, however, to further develop methods to provide characterization parameters and for providing user-friendly reporting products.

(c) The joint processing at the IDC of continuous data from a select, high-quality network of primary seismic stations is an effective means of detecting seismic events and achieving a preliminary location.

(d) Full redundancy of key equipment at the IDC is essential for reliable operations and to avoid loss of data. Key elements of the ISMS must be improved in terms of robustness and, often, redundancy in order to provide the 99% or higher reliability specified in CD/1254.

(e) NDCs play a critical role in the operation and maintenance of reliable stations and communication links, and form an effective interface between the IDC and participating States through which data and products can be accessed and evaluated.

(f) Regional communication nodes have proved useful during GSETT-3 and could, if equipped with sufficient redundancy, provide a back-up data storage capability if the IDC failed catastrophically. NDCs also have a useful back-up function.

(g) Seismic arrays at low noise sites will be the most valuable type of installation in the primary network of the seismic component of any proposed IMS. The GSETT-3 has shown the value of upgrading stations from three components to arrays. Digital data from stations with high operational capability and reliability are essential.

(h) The capability of the IDC to routinely and automatically retrieve supplementary data on request from a global network of auxiliary stations has been demonstrated.

(i) Limited experiments have been conducted to demonstrate mechanisms for system integrity, including data authentication. Further development and testing of authentication procedures and data and system security are, however, needed.

(j) The GSETT-3 has proven to be a valuable impetus to countries participating in the experiment for the installation of high-quality seismic equipment and communications equipment.

(k) The experiment has shown the necessity for stations to meet defined minimum technical specifications. The minimum recommended station requirements provided in CD/1254 is confirmed by the experience of GSETT-3 thus far.

(l) There has been a considerable and lengthy effort to establish the infrastructure needed for GSETT-3, including the stations, NDCs, the IDC and the communications links. The Ad Hoc Group considers it essential that the operation of key elements of this infrastructure that could contribute to the future IMS established under a CTBT be maintained.

7. The scientific results and capabilities demonstrated in GSETT-3 are not uniform in a geographical sense. Nevertheless, results to date allow the following preliminary points to be made:

(a) Considerable operational experience is necessary to achieve the potential capability of a seismic monitoring network. The capability of the GSETT-3 network has steadily improved since the beginning of the experiment. These improvements have been brought about by improvements in operational procedures at all levels, by improved data processing methods and by the addition of stations in the network.

(b) In regions of the world for which the planned primary network is nearly complete (i.e., North America, northern Europe, Australia), the network detects events with a magnitude of 3.5-4.0 with high probability. This supports the previous theoretical estimates of the global detection capability of a 50-60 station primary network and gives confidence that these theoretical estimates are correct on a global basis. However, the current capability is significantly less in other regions of the world, and must be improved.

(c) The combination of the primary network and an auxiliary network should be able to achieve a location accuracy of within 1,000 square kilometres. In regions of the world for which the planned network is nearly complete (i.e., North America, northern Europe, Australia), the location error of the primary network is estimated to be between 20-50 km for seismic events of magnitude 4. The use of auxiliary stations can reduce this to 15-25 km, based on GSETT-3 experience in the same areas. Previous work has demonstrated that calibration of the network can further improve location estimates, and this remains to be demonstrated in selected regions during GSETT-3.

(d) Participating countries have made available to the IDC supplementary information on seismic events based on analysing data from their own national networks, which are maintained to individual national standards. These supplementary data have proven useful in evaluating the performance of the GSETT-3 network and should be useful in improving the capability of the network by calibration.

(e) The experiment has shown that the current seismological network is inadequate for monitoring the southern oceanic areas. Data from a hydroacoustic network in these regions used in conjunction with the seismic network might be essential for monitoring seismic events of magnitude below 4 in these areas. More work is needed on this topic.

8. Costs

(a) GSETT-3 has reconfirmed the estimate made in CD/1254 that the investment costs for the GSETT-3 stations, communications links and IDC are approximately 180 million US$. This number comprises 150 million US$ invested prior to GSETT-3 and 30 million US$ in new investments.

(c) GSETT-3 has also reconfirmed the estimate made in CD/1254 that the yearly operations and maintenance costs for the GSETT-3 stations, communications links and IDC are approximately 30 million US$.

9. Documentation, Training and Participation

(a) A complete set of comprehensive Operational Manuals have been compiled for seismic stations, NDCs and the IDC. These Operational Manuals have proven essential to support the GSETT-3 system operations, data exchange and processing. These manuals should prove useful models for the Operations Manuals for the future ISMS.

(b) The GSETT-3 has demonstrated the importance of practical training of international staff at the IDC and of national staff at NDCs. This training, which is already taking place, should be continued and expanded.

(c) The GSETT-3 has also demonstrated that an international technical staff can work effectively together at the IDC. In fact, this international participation in the IDC work has been crucial to the success of GSETT-3.

10. Future plans

The Ad Hoc Group also discussed its future plans. The Group agreed upon a work program which is presented below. This work program gives an overview of and schedule for the remaining tasks envisaged for the completion and evaluation of the GSETT-3 monitoring system.

(a) Development of the GSETT-3 System

The Ad Hoc Group will provide continuing improvements to the operational procedures and methods for the system. For example, the following specific efforts are underway:

- Network Development: There will be a continuation of the step-by-step implementation of additional seismic facilities around the world. Efforts will be made to make the primary network of the GSETT-3 fully operational as envisaged by GSE and mentioned in Tables 1 and 2 in Annex 2. Efforts will also be made to supplement all the auxiliary stations offered by various countries and mentioned in the tables in Annex 2. Plans are underway to hold regional workshops in Africa and South America to increase participation of auxiliary stations.

- Communications: Work will continue to establish modern communications for reliable data transmission from stations in remote regions of China, Egypt, Pakistan and Russia. Efforts are also underway to explore new methods for reliable and cost-effective communications that offer redundant transmission paths between stations and data centres.

- International Data Centre: The IDC will incorporate new software to support a demonstration of calibration of the network and processing systems in selected regions. It will continue to issue a daily, high-quality bulletin of events and provide subscription services for all participants. The IDC products will be expanded to include additional event characterization parameters and to provide user-friendly reporting products that are useful to support both technical evaluation and national verification needs.

(b) Evaluation and Completion of GSETT-3

The Ad Hoc Group will complete a comprehensive evaluation of the first year of the GSETT-3 experiment with emphasis on specific technical issues that are needed to define the IMS. Based on this evaluation, the Group will develop a schedule and plan for the completion of GSETT-3.

(c) Transition of the GSETT-3 System and Experience

The Ad Hoc Group will examine the issues to be addressed in a transition from GSETT-3 to IMS operations. The Ad Hoc Group will develop a plan to address these issues, and thus would be prepared for a possible request by the CD. The Group will also continue to expand training programs in data processing and seismic data analysis at both the IDC and through national initiatives, and complete documentation of the operational aspects of GSETT-3 will be updated and expanded as a model for developing procedures for the IMS.

The above tasks will be completed in accordance with the following schedule:

August 1995- February 1996	Continue development of the GSETT-3 system, as described in section (a), with emphasis on improving network coverage, communications and IDC products and services.
November 1995	Complete the first draft of an evaluation report on the GSETT-3. Develop plan for completing GSETT-3.
	Develop initial list of auxiliary stations recommended for the seismic component of the IMS network.
	Develop initial draft plan for the transition of the GSETT-3 network to the IMS network.
	Meet in Geneva to discuss draft report, auxiliary station recommendations and GSETT-3 to IMS transition plan.
November 1995- February 1996	Complete the evaluation of the first year of GSETT-3. Develop and implement network calibration procedures.
February 1996	Meet in Geneva to complete a comprehensive report providing an evaluation of GSETT-3, based on the first year of operations.

Adopt plan for completion and transition of the GSETT-3 system to IMS.

Complete report on recommendation for auxiliary stations.

11. It was noted that facilities are incomplete for some of the stations envisioned as part of the GSETT-3 monitoring network (CD/1254). It is of particular importance to ensure financial resources for continuous data transmission, and for operation of other facilities during GSETT-3. Countries are encouraged to assist by providing technical and financial assistance in these areas to other countries whose participation is essential.

12. The Ad Hoc Group received and appreciated a briefing from the Chairman of the Nuclear Test Ban Committee's Working Group on Verification. Upon invitation by the Chairman, the Ad Hoc Group made a presentation to the Working Group on the GSETT-3 experiment.

13. The Ad Hoc Group noted with appreciation the convening of an informal technical workshop "From GSETT-3 to IMS" in Baltimore, Maryland, USA, from 26 through 29 June 1995. The workshop was attended by 55 technical experts from 20 countries. The objective of the workshop was to stimulate discussion on the evaluation and evolution of GSETT-3, and to consider ways to facilitate the transition of the experience gained from GSETT-3 to meet the needs of the Conference on Disarmament and of the future CTBT international organization. Many of the results of this workshop were provided during this session in reports of the national delegations and the Working Groups, and these reports will be valuable in guiding and expediting the future work of the GSE.

The Ad Hoc Group also noted with appreciation the convening of an informal technical seminar "Design, Usage, and Implementation of the AutoDRM" in Zurich, Switzerland, from 1 to 2 June 1995. This seminar, whose purpose was to consider common procedures for automated data exchange, was attended by 18 technical experts from 12 countries.

The Ad Hoc Group likewise noted with appreciation the convening of an informal technical seminar which was held in Bruyères le Châtel, France, from 12 to 13 July 1995 and attended by 17 participants from 7 European countries. The purpose of this seminar was to review initial results of the EUROBULL experiment, whose objective is to produce a high quality European seismic bulletin on a routine basis. Plans for continuation and expanding the participation were also discussed.

14. The Ad Hoc Group suggests that its next sessions, subject to approval by the Conference on Disarmament, should be convened from 27 November through 1 December 1995, followed by a session from 12 through 23 February 1996, to carry out the work plan presented in paragraph 10. A draft work programme for the next session is presented in Annex 3. The work programme will be tailored to meet as much as practicable the information needs of the Ad Hoc Committee on a Nuclear Test Ban and its Working Group on Verification.

Annex 1

Summary Report on Status and Plans for GSETT-3

1. Introduction

On 1 January 1995, the Ad Hoc Group of Scientific Experts (GSE) Third Technical Test, GSETT-3, successfully began full-scale operations. As stated in CD/1254, the primary objectives of GSETT-3 are to:

- Develop and test new concepts for an experimental International Seismic Monitoring System (ISMS), building upon previous experience;

- Provide a practical basis upon which to furnish the Conference on Disarmament with timely technical information;

- Develop an experimental system that can evolve and adapt to support future requirements that may be specified for an International Seismic Monitoring System.

The concepts for an experimental seismic monitoring system to be tested during GSETT-3 include: a single centralized International Data Centre (IDC), a specifically designed high-quality seismographic network consisting of about 50 primary (Alpha) stations and 100-150 auxiliary (Beta) stations, National Data Centres (NDCs) in participating countries, and a modern communications system to support data exchange among these elements.

The IDC has been in operation since 1 January 1995, with the processing and analysis methods at the IDC being continuously improved as experience is gained. As of this date, 37 primary and 75 auxiliary stations are participating in the experiment. This participation is detailed in the tables and figures in Annex 2.

The global station coverage is presently uneven, and many of the conclusions drawn are based on observational data from selected regions only. These are regions with station coverage corresponding to the original GSETT-3 plan, and the observational results are supplemented by theoretical modelling and are continuously evaluated. Although the number of stations currently participating falls short of that envisaged when the experiment was planned, there is wide enough participation to begin to draw practical conclusions regarding several aspects of the ISMS concept. Some of the most important conclusions are summarized in the Progress Report, and additional details are provided below.

2. GSETT-3 Participation

The global seismograph network envisaged for GSETT-3 is a two-tiered network comprising the so-called primary and auxiliary seismograph stations. The primary stations are designed and located to provide

detection and initial location of seismic events throughout the world. The station waveform data are telemetered continuously to the IDC.

The auxiliary stations provide supplementary data, so that events can be located and characterized with improved accuracy. Data from auxiliary stations are not telemetered continuously to the IDC, but waveform segments can be retrieved automatically.

2.1 Primary stations

As of 18 August 1995, 37 stations in the envisaged 60-station GSETT-3 primary network are providing data to the IDC. Only five primary stations have been added to the network since the 40th GSE session in February, which is somewhat disappointing in view of the fact that 49 primary stations were committed for participation already by the time of the February session. It is, however, realistic to assume that at least an additional 5 primary stations will soon take part in GSETT-3, based on information received from primary station host countries during the 41st session. The work related to obtaining commitments for the remaining stations of the primary network has continued, most notably by a visit in May to several Permanent Missions to the United Nations in New York.

2.2 Auxiliary stations

As of 18 August 1995, 106 stations have been offered for the auxiliary station network and 99 of these have been committed for participation in GSETT-3. Out of these 99 stations, 75 are currently used by the IDC, which is an increase from 44 at the time of the 40th GSE session. Still, the geographical distribution of the current auxiliary station network is rather uneven, and many additional candidate auxiliary stations around the world that meet the technical requirements and that are of potential usefulness to GSETT-3 have been identified, in close cooperation with the member networks of the Federation of Digital Seismograph Networks (FDSN).

The GSE is seeking formal commitments for participation in GSETT-3 in direct contact with the authorities of the host countries of such candidate stations. Many positive responses have been received to letters written by the GSE Chairman, but 16 countries have not yet responded to such requests. For some countries, positive responses have been received, but work is underway to determine to which station(s) the commitment received actually applies.

It is still conceivable that the number of auxiliary stations in the GSETT-3 network might approach 150.

3. GSETT-3 Operations

After the flurry of activity which resulted from preparations for the successful start of the full scale test on 1 January 1995, operational procedures at both the NDCs and at the IDC have become more routine with the result that attention is now being directed towards optimizing the whole of the GSETT-3 system and improving its capabilities. A detailed

statistical overview of IDC operations and, to a lesser extent, of station and NDC participation, is provided in the bi-weekly performance reports. These reports may be retrieved electronically using the file transfer protocol (ftp) or by interacting with the IDC World-Wide Web(WWW) server on the Internet.

3.1 Status

As Table 1 shows, there are now 33 countries actively participating in GSETT-3 by submitting data to and/or retrieving data from the IDC. Although the station distribution is still far from uniform, data are arriving at the IDC from every continent. The number of primary stations sending continuous, near-real time data to the IDC has increased to 37 while the number of auxiliary stations accessed by the IDC has increased to 75. Communications links and data transmission software from the primary stations to the IDC (often through a communications hub at an NDC) have performed adequately. As a result of further upgrading of the procedures at the IDC, NDC and stations, the reliability of acquiring data from auxiliary stations using direct dial-up and GSE automatic Data Request Manager (AutoDRM) messages via electronic mail, has improved markedly.

Fourteen NDCs (Australia, Canada, Denmark, Finland, France, Italy, Japan, New Zealand, Romania, Russia, Spain, Switzerland, the United Kingdom and the United States) are submitting Gamma data in the form of independent seismic event lists. These data are typically more than one month behind real time but are still useful for evaluating and calibrating the GSETT-3 network. These data are now parsed automatically into the IDC database and are available for on-line access by the NDCs.

Starting 1 January 1995, the IDC began full-scale operation seven days per week and 24 hours per day. The IDC produces automatically an Alpha Event List (AEL) based on signals detected in the real time, continuous waveform data from primary stations. Auxiliary waveform segments, which are based on AEL event locations, are then automatically retrieved and an Alpha/Beta Event List (ABEL) is produced. The waveform data is interactively reviewed to produce a Reviewed Event Bulletin (REB). The target times for completing the automatic bulletins are 1 hour (AEL) and 4 hours (ABEL) after event time. The target time for the REB is two days after the end of the data day. With minor exceptions, which have been associated either with large aftershock sequences or with instabilities in a developing system, these target times have been adhered to. REBs have been produced for all data days except for the period 8 May through 14 May when a major malfunction in the redundant array of independent disks prevented data recovery from both the on-line primary and back-up versions of the IDC database. To ensure that any future failures will not have the same consequences, the IDC now maintains three copies of all current on-line data.

Table 1

	1 Feb 1994	20 Aug 1994	20 Feb 1995	18 Aug 1995	Plan
Participating Nations	10	13	28	33	>40
Primary Stations	6	12	32	37	60
Auxiliary Stations	13	21	44	75	~150
Coverage	European	Sparse Global	Global	Global	Global
NDCs Sending Gamma Data	1	5	11	14	20-30
Volume of Data/Day to IDC	0.2 Gbytes	1.5 Gbytes	2.5 Gbytes	2.5 Gbytes	>5 Gbytes
Data Days/Week	2	3	7(24 hrs/ day)	7 (24 hrs/day)	7(24hrs /day)
REB Events/day	20	20	60	60	>100
REB Events Total	1,500	2,700	6,800	12,250	
IDC Staff (int'l)	27(0)	27(0)	47(9)	50(10)	50(9)

There are on average more than 60 events in the REBs each day. This number is not constant but fluctuates widely to over 200 events per day when large earthquakes with their consequent aftershock sequences occur. That both the system and analysis staff can handle these increased loads is encouraging.

Estimates of the magnitude threshold at the 90% confidence level, for detection of a seismic disturbance by three stations in the primary network, range from mb 3.1 in limited areas of northern Europe up to mb 4.7 in the southern oceans. These estimates reflect the geographical distribution and detection capabilities of stations in the current primary network. Typical location uncertainties for events within 2000 km of the closest station are between 40 and 50 km. Completion and calibration of the station network by the use of regional, rather than globally averaged, travel times will improve the detection capability and reduce the location uncertainty.

The number of staff at the IDC is now 50, including 10 international visiting experts. International staffing and training continues to be a high priority of the Working Group on Operations. At the last GSE session, a Working Group paper was tabled inviting GSETT-3 participants to apply for positions at the IDC. The responses have been reviewed during the current session and offers will be extended to the successful candidates.

The IDC is not an operational system; rather it is a prototype system that is evolutionary in nature and is changing as information is gathered during the GSETT-3, as new analysis algorithms are developed and as existing algorithms are improved. Signal processing and automatic association of arrivals to seismic events are major components of the data processing and interpretation segment of the IDC. The signal processing module detects seismic signals and extracts features for subsequent processing and interpretation. These features include signal onset time, azimuth and slowness, polarization parameters, amplitudes, period, signal/noise ratio and others. Based on these features, the automatic association module group detections that appear to come from the same event identify the seismic phases in terms of wave type and propagation paths, and locate events using theoretical Earth models.

The signal processing modules will be replaced with a single new program called DFX (Detection and Feature Extraction). The objectives of this new software package are to improve the quality control and robustness of the feature measurements, generalize the knowledge representation, facilitate the addition of new algorithms and ensure consistency between results from automatic analysis and analyst review. The modules which are used for automatic event association and event location will also be replaced with a new collection of programs called the Global Association (GA) system which uses a gridded search technique. The objectives have been to speed up the event formation process through parallelization and to improve the quality of the automated event lists by reducing the number of missed events.

Surface wave magnitudes (Ms) are an important diagnostic parameter for characterizing the source of the larger events. In May, an automatic procedure for identifying surface waves, estimating their amplitudes and calculating surface wave magnitudes, was implemented at the IDC. Initially, Ms was only calculated for stations with long period channels. Subsequent enhancements of these automatic procedures allow for the computation of surface wave magnitudes from broad-band data channels and long-period arrays. Regional magnitudes (ML) are now also being calculated automatically and included in the REBs. The current automatic procedures use a set of standardized attenuation curves. Regional specific attenuation curves will be incorporated as they become available.

Significant enhancements have been made to the automatic auxiliary data retrieval system with the result that the IDC is now requesting, retrieving and processing much more auxiliary data than earlier in the year. Auxiliary data is currently being requested for about half of the events reported in the REBs. The use of auxiliary data together with analyst review are the major factors in reducing location errors and in improving the quality of the REBs. One of the consequences of the

increased auxiliary data contributions has been the discovery of anomalies in instrument response that have been supplied to the IDC, and which have been responsible for some of the station magnitude outliers reported in the REB. IDC staff have worked with NDCs and station operators to correct and update this information as necessary.

An important objective of the IDC data processing is to optimize the automatic procedures and so reduce the amount of interactive analysis. A study of signal processing results for the period 19 February - 1 April has been used to develop new automatic detection parameter recipes for all stations in the primary network. These new recipes were implemented on 2 June and have significantly reduced the number of false detections. At the same time the number of valid detections has increased. Further optimization of these detection recipes will be carried out at periodic intervals.

The data access facilities at the IDC continue to improve. Since the last session, access facilities to the IDC database using the GSE AutoDRM and electronic mail have been upgraded.

The options for obtaining information by subscription have also been extended. It is now possible to tailor subscription requests to obtain bulletin information which is restricted to events from nominated areas, and have magnitudes and depths within specified limits, etc. The IDC World Wide Web (WWW) server has been extensively upgraded and expanded to improve its functionality, to make it more user friendly and to provide access to a larger range of IDC products and services.

The GSETT-3 IDC is not providing identification on detected events, but it has begun compiling a number of agreed parameters which characterize the detected signals and which may assist participating countries in identifying the source of each seismic disturbance. In preparation for adding these event characterization parameters to the near-real time operational pipeline, the IDC has gone back to compute the first subset of these parameters for a one-month period in January and February. Further subsets will be computed as resources permit. NDCs have been invited to access these characterization parameters and to provide comments on them, including: are the parameters computed correctly; are they useful; and which additional parameters might also be useful.

3.2 Operational Plans

A number of significant changes are expected to take place within the IDC over the next six months. It is expected that between 10 and 15 new primary stations, 20 to 40 new auxiliary stations and Gamma data from additional NDCs will be available during this period. The further refinement of the primary and auxiliary acquisition systems will be an important accompaniment to these new data sources. Additional hardware, including a 5 terabyte mass store, will be added to the system. This mass store will allow all raw data and processed products to be accessible, on-line, for a period of several years.

Further upgrading and tuning of the signal processing, automatic association and location software, and the incorporation of an expanded knowledge base into this software, will increase the quality of the IDC products. It will also reduce the analysts' workload. The knowledge base will include regional specific travel times and attenuation curves as well as event locations and source types (Gamma data). Acquiring this knowledge and incorporating it into the IDC processing systems will be a priority and will require active participation and contributions from all NDCs as well as from the IDC. To facilitate participation, Points of Contact (POC) personnel have been nominated at the IDC. The role of these POCs is to act as liaison officers between the NDCs and the various aspects of the IDC operations.

The IDC products will be expanded to include additional event characterization parameters. All IDC data and processed products will be more easily accessible as a result of additional functionality being incorporated into the IDC AutoDRM, the Subscription modules and the WWW server.

4. GSETT-3 Documentation

The GSETT-3 Documentation, CRP/243, comprises the plan for GSETT-3, technical instructions, factual descriptions of facilities to be used, an evaluation plan and numerous technical annexes. This voluminous documentation forms the basis for operations manuals and procedures for GSETT-3. It will also contain technical summaries of IDC and station operations and ongoing evaluation results during GSETT-3. Previous experience has shown that documentation of this type is essential.

A draft version of the GSETT-3 Documentation was produced and distributed in advance of the 39th GSE session in August 1994, and an updated version of this documentation was distributed during the 40th GSE session in February 1995.

Since the 40th session, work has continued to finalize the GSETT-3 documentation, and significant progress was made at a documentation meeting in the United States in May. During and following this meeting, missing text was added, the volumes and annexes were unified with respect to format, style and content, and the documentation was slightly reorganized relative to previous versions. The completed GSETT-3 Documentation is being mailed to the home addresses of GSE delegates.

5. GSETT-3 Evaluation

The Working Group on Evaluation (WGE) visited the prototype International Data Centre (IDC) at the end of June 1995 to prepare its second Evaluation Report on the Experimental International Seismic Monitoring System (EISMS), covering the six-month period from January to June 1995. This evaluation took advantage of many national contributions presented during the GSE Informal Technical Workshop in Baltimore (26 to 29 June).

5.1 Status

Currently there are 37 primary stations (8 more than in January 1995) on-line to the IDC and routine analysis shows that almost all are of high quality, with low noise levels. Although a wide variety of instrumentation is employed at the current primary stations, no adverse effects have been observed. The auxiliary network currently consists of 75 stations. Their number has increased steadily and their impact on event location capability has been clearly demonstrated for some source regions. Nevertheless, application of corrections on azimuth and travel times to take into account the effect of local geology, as recommended in the previous WGE report, is still needed.

The communication links continue to show high reliability, independent of the physical means used (satellite, fibre optic, cable, etc). However, the overall data availability from most of the primary stations (due to a combination of communications links, NDC, IDC and station problems) is far from meeting the 99% target for EISMS stations. Testing of data authentication procedures will be conducted during the next few months.

To date, fifty countries are committed to participating in GSETT-3 and many are in the process of establishing their NDC to provide data and to evaluate their contributions. These NDCs are obviously giving priority to establishing and maintaining their primary and auxiliary stations, thus limiting the time for participation in evaluation tasks. However, the number and quality of papers presented at the Baltimore Workshop was encouraging and shows that many NDCs are aware of the need for their contribution to the evaluation of GSETT-3. The WGE must stress that many more NDCs need to participate in evaluation tasks by sending their Evaluation Reports to the IDC. The information contained in such reports is needed to assess many aspects of the GSETT-3 experiment, including the costs.

The total cost of the IDC operations is 10 million US$ for the present fiscal year, including technical support, communications, development and salaries for a staff of 50 people devoted to operations (23), technical support (17) and other services. In May/June 1995, a quality assurance evaluation of the IDC was carried out. The chief findings were that the contribution of the international experts working at the IDC has been significant, but that the security of the system against data loss is inadequate. The back-up of data to ensure no loss in case of hardware failure needs to be improved. This was clearly demonstrated recently when a disk crash put the IDC out of operation for 6 days and lead to the loss of primary data during that period. More generally, the frequency of serious system failures needs to be reduced.

Reviewed Event Bulletins (REBs) are generated on a daily basis and the basic statistics necessary for the evaluation of GSETT-3 are being accumulated, but the reliability of these processes might be affected by recurrent disk crashes or software problems.

The AutoDRM has been improved and provides more functions, although some of the functions are still missing and responses remain irregular. The IDC contribution through the World Wide Web (WWW) has also improved.

Gamma (or contributed) data are now parsed or inserted into the IDC data base and the retrieval mechanism for data from auxiliary stations is performing better although it still needs improvement.

So far the IDC has concentrated on operations, and tuning of event detection processes has been a low priority task. The problem of spurious detections needs to be solved. Additionally, clear signals with no automatic detection by IDC processes have been identified.

In May 1995, the IDC started processing surface waves from stations with long period instruments, and, more recently, on stations with broad band instruments. MS and ML magnitudes are now computed on a routine basis.

Significant progress has been achieved since February 1995 on event definition, resulting in automatically formed event lists that are closer to the final REB products. However, 20-30% of the events in the final REB are added during analyst review and about 40% of the events automatically formed are rejected by analysts. Since January, the fraction of REB events for which auxiliary data have been retrieved has been nearly constant at around 50 to 60%, which is too low. This is probably due to missing events in the automatic event list, inadequate criteria for data retrieval, technical problems with auxiliary data retrieval, and the sparse and uneven distribution of auxiliary stations.

5.2 Capabilities

The event location capability of the EISMS can be improved with the use of auxiliary data; the size of the confidence ellipse could be reduced particularly in cases where the nearest primary stations are located at far regional or teleseismic distances.

Several NDCs have compared the REB locations with their Gamma data. In the United States (US), the mean location difference was 35 km, in Japan 50 km, in Spain 80 km and in Finland and nearby countries no more than 20 km. A global approach compared REB locations with those in the weekly version of the Preliminary Determination of Epicentres (PDE, a standard worldwide bulletin published in the US). A result of this comparison was that the median location difference for common events decreased from several tens of kilometres at magnitude (mb) 3.5 to about 20 km at magnitudes above 5.5. Nevertheless, another study of IDC results showed that only 20% of the events in the REB had confidence ellipses with areas less than 1,000 km and 35% have confidence ellipses with areas exceeding 10,000 km.

The depths of focus for deep events in the REBs usually compared well with depths given in other bulletins, but this is not so for shallow events. Depths were estimated for only 30% of events reported in the REB.

A questionnaire was distributed to the NDCs in order for the WGE to assess quality of bulletins based on Gamma data. To date 22 out of 28 NDCs have responded to the questionnaire. The WGE urges NDCs that have not responded to do so.

As observed in the IDC Performance Reports, the detection capability of the network has not significantly changed since February 1995, i.e., the network event detection threshold varies from (mb) 3.5 - 4.5 and may be even higher in some regions of the southern hemisphere. These estimates are in good agreement with theoretical simulations and reflect the uneven distribution of stations with sparse coverage of Africa, South America and much of Asia.

5.3 Evaluation plans

In summary, there have been significant improvements in both data processing and procedures during the past six months. However, there are still some important goals to be achieved. Most urgent is the necessity of greater involvement of NDCs both in the contribution of stations and in participation in evaluation tasks. The IDC should continue to improve the quality assurance procedures and provide a documented plan to calibrate and tune the network. The IDC should also give priority to refining automatic procedures and event location, including depth estimation, especially for shallow events.

The next evaluation period should confirm the increased performance of the EISMS through the application of such recommendations.

Annex 2

Table 1: Status of GSETT3 Station and Gamma Data Commitments as of 18 August 1995

Country	Alpha Stations Envisaged by GSE	Beta Stations Offered	Station Commitment Status	Data Available to IDC	Gamma Data Committed
Argentina	1	1	committed	1994/Jan. 1996	yes
Australia	5	12	committed	1994	yes
Austria	0	1	lacking	1995	-
Belgium	0	0	not applicable	not applicable	yes
Bolivia	1	-	committed	Aug. 1995	-
Botswana	1	-	lacking	unknown	-
Brazil	1	2	committed/lacking	1994/1995	-
Bulgaria	0	1	committed	1995	yes
Canada	6	18	committed	1994	yes
Cen. Afr. Republic	1	-	committed	1994	-
Chile	0	1	committed	-	-
China	3	0	committed	Sept. 1995	yes
Colombia	1	0	committed	1995	yes
Cook Islands	0	1	committed	1994	-
Costa Rica	0	1	committed	-	-
Czech Republic	0	1	committed	1994	yes
Denmark	1	0	lacking	unknown	yes
Egypt	1	0	lacking	unknown	-
Ethiopia	0	1	committed	March 1995	-
Finland	1	2	committed	1994	yes
France	1	0	committed	Jan. 1995	yes
Germany	1	9	committed	1994	yes
Hungary	0	1	committed	1994	yes
Iceland	0	1	committed	-	-
India	1	0	committed	unknown	-
Indonesia	1	-	lacking	unknown	-
Iran	1	1	committed	1995	yes
Israel	0	1	committed	July 1995	yes
Italy	0	2	committed	1994	yes
Ivory Coast	1	-	committed	June 1995	-
Japan	1	7	committed	1994/Sept. 1995	yes
Kazakhstan	1	-	committed	unknown	-
Kenya	1	-	lacking	unknown	-
Rep. of Korea	1	-	lacking	unknown	-
Mexico	1	2	lacking	unknown	-
Mongolia	1	1	committed	1995	-
Netherlands	0	1	committed	1994	yes
New Zealand	0	1	committed	1994	yes
Norway	3	1	committed	1994/1995	yes
Pakistan	1	1	committed	1995	-
Papua New Guinea	1	-	committed[1]	Jan. 1995	-

1. Envisaged Alpha station currently used as Beta station

Country	Alpha Stations Envisaged by GSE	Beta Stations Offered	Station Commitment Status	Data Available to IDC	Gamma Data Committed
Paraguay	1	-	committed	1994	-
Peru	0	1	committed	1995	yes
Philippines	0	1	committed	-	-
Poland	0	1	lacking	unknown	yes
Portugal	0	1	committed	-	-
Romania	0	1	committed	1996	yes
Russian Federation	5	5	committed	1994/1995	yes
Seychelles	0	1	committed	-	-
Solomon Islands	0	1	committed	March 1995	-
South Africa	1	1	committed	1994/1995	yes
Spain	1	2	committed	Jan. 1995	yes
Sweden	1	0	committed	Jan. 1995	yes
Switzerland	0	1	committed	Jan. 1995	yes
Thailand	1	-	committed	Feb. 1995	-
Tunisia	1	-	lacking	Late 1995	-
Turkey	1	-	committed	unknown	-
Turkmenistan	1	-	committed	Aug. 1995	-
Ukraine	0	1	committed	1995	-
United Kingdom	0	3	committed	1994/1995	yes
United States	7	12	committed	1994/1995	yes
Venezuela	0	1	committed	1995	-
Western Samoa	0	1	committed	1994	-
Zambia	0	1	committed	Jan. 1995	-
TOTAL (Committed)	60(50)	106 (99)	53 countries		30

Table 2: GSETT-3 Stations

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
Argentina						
Paso Flores	PLCA	α	3-C	-40.731	-70.550	yes
Coronel Fontana	CFA	β	3-C	-31.607	-68.239	no
Australia						
Alice Springs	ASAR	α	array	-23.666	133.904	yes
Mawson, Antarctica	MAW	α	3-C	-67.604	62.871	yes
Stephens Creek	STKA	α	3-C	-31.882	141.592	yes
Warramunga	WRA	α	array	-19.943	134.339	yes
Woolibar	WOOL	α	3-C	-31.073	121.678	yes
Armidale	ARMA	β	3-C	-30.420	151.628	yes
Casey	CSY	β	1-C	-66.289	110.529	yes
Charters Towers	CTA	β	3-C	-20.088	146.254	yes
Fitzroy Crossing	FITZ	β	3-C	-18.103	125.643	yes
Forrest	FORT	β	1-C	-30.779	128.059	yes
Meekatharra	MEEK	β	1-C	-26.614	118.536	yes
Mount Isa	QIS	β	1-C	-20.558	139.605	yes
Narrogin	NWAO	β	3-C	-32.927	117.233	yes
Roma	RMQ	β	1-C	-26.489	148.755	yes
Toolangi	TOO	β	3-C	-37.571	145.491	yes
Warburtan	WARB	β	3-C	-26.184	126.643	yes
Young	YOU	β	1-C	-34.278	148.382	yes
Austria						
Molln	MOA	β	3-C	47.850	14.266	no
Bolivia						
La Paz	LPAZ	α	3-C	-16.288	-68.131	yes

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
Botswana						
Lobatse	LBTB	α	3-C	-25.015	25.597	no
Brazil						
Brasilia	BDFB	α	3-C	-15.642	-48.015	yes
Pitinga	PTGA	β	3-C	-3.060	-60.000	no
Rio Grande do Norte	RGNB	β	3-C	-6.910	-36.950	no
Bulgaria						
Vitosha	VTS	β	3-C	42.618	23.238	no
Canada						
Lac du Bonnet	ULM	α	3-C	50.250	-95.875	yes
Mould Bay	MBC	α	3-C	76.242	-119.360	yes
Schefferville	SCHQ	α	3-C	54.817	-66.783	yes
Waterton Lakes	WALA	α	3-C	49.059	-113.912	yes
Whitehorse	WHY	α	3-C	60.660	-134.881	yes
Yellowknife	YKA	α	array	62.493	-114.605	yes
Bella Bella	BBB	β	3-C	52.185	-128.113	yes
Caledonia Mtn.	LMN	β	3-C	45.852	-64.806	yes
Dawson City	DAWY	β	3-C	64.066	-139.391	yes
Dease Lake	DLBC	β	3-C	58.417	-130.060	yes
Deer Lake	DRLN	β	3-C	49.256	-57.504	yes
Edmonton	EDM	β	3-C	53.222	-113.350	yes
Eldee	EEO	β	1-C	46.641	-79.073	yes
Fort Churchill	FCC	β	3-C	58.761	-94.087	yes
Glen Almond	GAC	β	3-C	45.703	-75.478	yes
Inuvik	INK	β	3-C	68.307	-133.520	yes
Iqaluit	FRB	β	3-C	63.747	-68.547	yes
La Malbaie	LMQ	β	3-C	47.548	-70.327	yes

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
Pac. Geoscience	PGC	β	3-C	48.650	-123.451	yes
Pemberton	PMB	β	3-C	50.520	-123.073	yes
Penticton	PNT	β	3-C	49.317	-119.617	yes
Resolute Bay	RES	β	3-C	74.687	-94.900	yes
Sadowa	SADO	β	3-C	44.769	-79.142	yes
Thunder Bay	TBO	β	1-C	48.647	-89.408	yes
Central African Republic						
Bangui	BGCA	α	3-C	5.176	18.424	yes
Chile						
To be defined		β	3-C			no
China						
Beijing	BJT	α	3-C	40.040	116.180	no
Hailar	HIA	α	3-C	49.267	119.742	no
Lanzhou	LZH	α	3-C	36.087	103.844	no
Colombia						
To be defined	XSA	α	3-C			no
Cook Islands						
Rarotonga	RAR	β	3-C	-21.213	-159.773	yes
Costa Rica						
Las Juntas de Abangares	JTS	β	3-C	10.290	-87.950	no
Czech Republic						
Vranov	VRAC	β	3-C	49.311	16.596	yes
Denmark						
Danmarkshavn	DAG	α	3-C	76.770	-18.650	no
Egypt						
LUXESS	LXAR	α	array	26.000	33.000	no

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
Ethiopia						
Addis Ababa	AAE	β	3-C	9.029	38.766	yes
Finland						
FINESS	FINES	α	array	61.444	26.077	yes
Kangasniemi	KAF	β	3-C	62.113	26.306	yes
Ylistaro	VAF	β	3-C	63.042	22.672	yes
France						
Lormes	LOR	α	3-C	47.268	3.859	yes
Germany						
GERESS	GERES	α	array	48.845	13.702	yes
Berggiesshübel	BRG	β	3-C	50.875	13.947	yes
Black Forest	BFO	β	3-C	48.331	8.330	yes
Bochum	BUG	β	3-C	51.446	7.264	yes
Clausthal-Zellerfeld	CLZ	β	3-C	51.843	10.374	yes
Collm	CLL	β	3-C	51.310	13.000	yes
Fürstenfeldbruck	FUR	β	3-C	48.164	11.277	yes
Gräfenberg	GRFO	β	3-C	49.692	11.205	yes
Moxa	MOX	β	3-C	50.646	11.616	yes
Taunus	TNS	β	3-C	50.224	8.449	yes
Hungary						
Piszkes	PSZ	β	3-C	47.918	19.895	yes
Iceland						
Borgarnes	BORG	β	3-C	64.500	-21.500	no
India						
Gauribidanur	GBA	α	array	13.604	77.436	no
Indonesia						

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
To be defined	XIN	α	3-C			no
Iran						
Teluran	THR	α	3-C	35.818	51.393	no
To be defined		β	3-C			no
Israel						
Bar Giyora	BGIO	β	3-C	31.722	35.092	yes
Italy						
L'Aquila	AQU	β	3-C	42.354	13.405	yes
Villasalto	VSL	β	3-C	39.496	9.378	yes
Ivory Coast						
Dimborko	DBIC	α	3-C	6.670	-4.856	yes
Japan						
Matsushiro	MJAR	α	array	36.543	138.207	yes
Aobayama	AOB	β	3-C	38.250	140.850	no
Chichijima	OGS	β	3-C	27.060	142.200	no
Hachijojima	HCH	β	3-C	33.120	139.800	no
Ishigakijima	ISG	β	3-C	24.380	124.230	no
Kaminokuni	KKJ	β	3-C	41.780	140.180	no
Shiraki	SHK	β	3-C	34.530	132.680	no
Tsukuba	TSK	β	3-C	36.210	140.110	no
Kazakhstan						
Aktubinsk	AKT0	α	array	50.434	58.018	no
Kenya						
Nairobi	KMBO	α	3-C	-1.274	36.804	no
Korea, Republic of						
To be defined	XKO0	α	array	37.000	128.000	no

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
Mexico						
To be defined	XMEX	α	3-C	18.000	-96.000	no
Chilapa	CHAM	β	3-C	17.000	-99.000	no
Iguala	IGUM	β	3-C	19.000	-100.000	no
Mongolia						
To be defined	XMON	α	3-C			no
Ulaan-Baatar	ULN	β	3-C	47.520	107.030	yes
Netherlands						
Heimansgroave	HGN	β	3-C	50.764	5.932	yes
New Zealand						
South Karori	SNZ0	β	3-C	-41.310	174.705	yes
Norway						
ARCESS	ARCES	α	array	69.535	25.506	yes
NORSAR	NAO	α	array	60.824	10.832	no
Spitsbergen	SPITS	α	array	78.178	16.370	yes
NORESS	NORES	β	array	60.735	11.541	yes, as α station
Pakistan						
Pari	PKAR	α	array	33.050	73.252	no
Nilore	NIL	β	3-C	33.600	73.100	no
Papua New Guinea						
Port Moresby	PMG	α	3-C	-9.409	147.154	yes, as β station
Paraguay						
Villa Florida	CPUP	α	3-C	-26.331	-57.329	yes
Peru						
Nana	NNA	β	3-C	-11.990	-76.840	no

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
Philippines						
To be defined		β	3-C			no
Poland						
To be defined		β	3-C			no
Portugal						
To be defined		β	3-C			no
Romania						
Muntele Rosu	MLR	β	3-C	45.492	25.944	no
Russian Federation						
Khabaz	KBZ	α	3-C	43.729	42.898	no
Norilsk	NRI	α	3-C	69.400	88.100	no
Peleduy	PDY	α	3-C	59.633	112.700	yes
Ussuriisk	USK	α	3-C	44.283	132.083	no
Zalesovo	ZAL	α	3-C	53.940	84.805	no
Arti	ARU	β	3-C	56.430	58.563	yes
Kislovodsk	KIV0	β	array	43.956	42.695	yes
Obninsk	OBN	β	3-C	55.117	36.600	yes
Urgal	URG	β	3-C	51.099	132.364	no
Zilim	UFA	β	3-C	53.850	57.050	no
Seychelles						
Mahe	MSEY	β	3-C	-4.610	55.490	no
Solomon Islands						
Honiara	HNR	β	3-C	-9.432	159.947	yes
South Africa						
Boshof	BOSA	α	3-C	-28.614	25.556	yes
Silverton	SLR	β	3-C	-25.740	28.280	no

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
Spain						
Sonseca	ESDC	α	array	39.677	-3.962	yes
San Pablo de los Montes	PAB	β	3-C	39.546	-4.348	yes
Taburiente	TBT	β	3-C	28.679	-17.913	yes
Sweden						
Hagfors	HFS	α	array	60.134	13.697	yes
Switzerland						
Alpnach	APL	β	3-C	46.950	8.243	yes
Thailand						
Chiang Mai	CMAR	α	array	18.458	98.943	yes
Tunisia						
Thala	THA	α	3-C	35.560	8.700	no
Turkey						
To be defined	XTUR	α	array	39.000	34.000	no
Turkmenistan						
Alibek	ABKT	α	3-C	37.930	58.119	yes
Ukraine						
Kiev	KIEV	β	3-C	50.694	29.208	yes
United Kingdom						
Eskdalemuir	EKA	β	array	55.333	-3.159	yes
Wolverton	WOL	β	3-C	51.313	-1.223	no
Ascension Island	ASCN	β	3-C	-7.950	-14.380	no
United States						
Lajitas	TXAR	α	array	29.334	-103.667	yes
Lisbon	LBNH	α	3-C	44.240	-71.926	yes
Mount Ida	MIAR	α	3-C	34.546	-93.573	yes

Station Name (in alphabetical order by country and type)	Code	Type	Station Type	Latitude	Longitude	Data used by IDC as of 18 August 1995
North Pole	NPO	α	3-C	64.771	-146.887	yes
Pinedale	PDAR	α	array	42.767	-109.558	yes
Pinon Flats	PFO	α	3-C	33.609	-116.455	yes
Vanda, Antarctica	VNDA	α	3-C	-77.514	161.846	yes
Albuquerque	ALQ	β	3-C	34.946	-106.457	yes
Black Hills	RSSD	β	3-C	44.120	-104.036	yes
Blacksburg	BLA	β	3-C	37.211	-80.421	yes
Dugway	DUG	β	3-C	40.195	-112.816	yes
Elko	ELK	β	3-C	40.745	-115.239	yes
Ely	EYMN	β	3-C	47.947	-91.508	yes
Kanab	KNB	β	3-C	37.020	-112.820	no
Mina	MNV	β	3-C	38.433	-118.153	yes
Newport	NEW	β	3-C	48.263	-117.120	yes
Tucson	TUC	β	3-C	32.310	-110.785	yes
Tuckaleechee Caverns	TKL	β	3-C	35.658	-83.774	yes
Tulsa	TUL	β	3-C	35.911	-95.793	yes
Venezuela						
Santo Domingo	SDV	β	3-C	8.879	-70.633	yes
Western Samoa						
Afiamalu	AFI	β	3-C	-13.909	-171.779	yes
Zambia						
Lusaka	LSZ	β	3-C	-15.277	28.188	yes

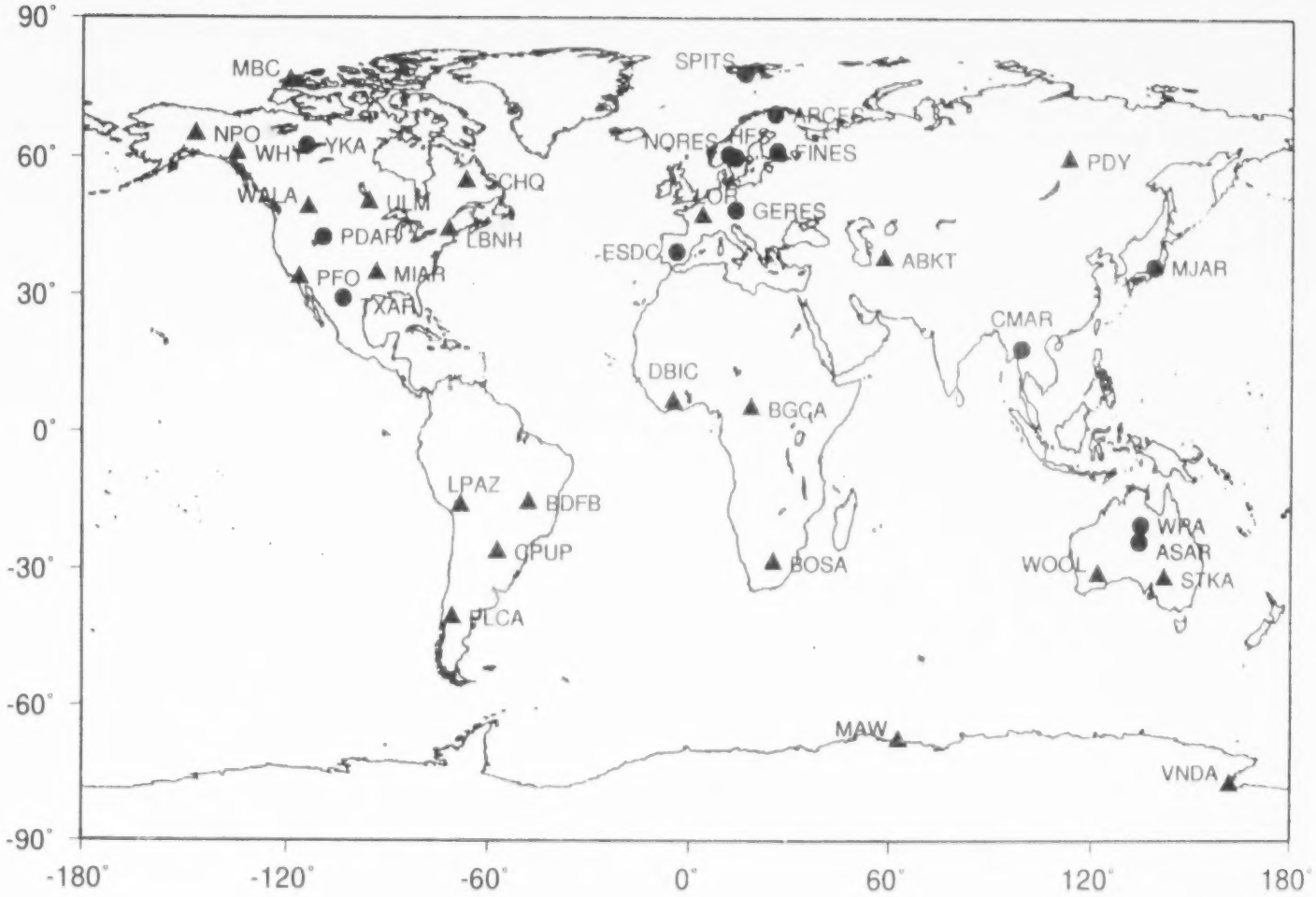

Fig. 1. Alpha stations used by the IDC as of 18 August 1995. Arrays are shown as filled circles and three-component stations as filled triangles.

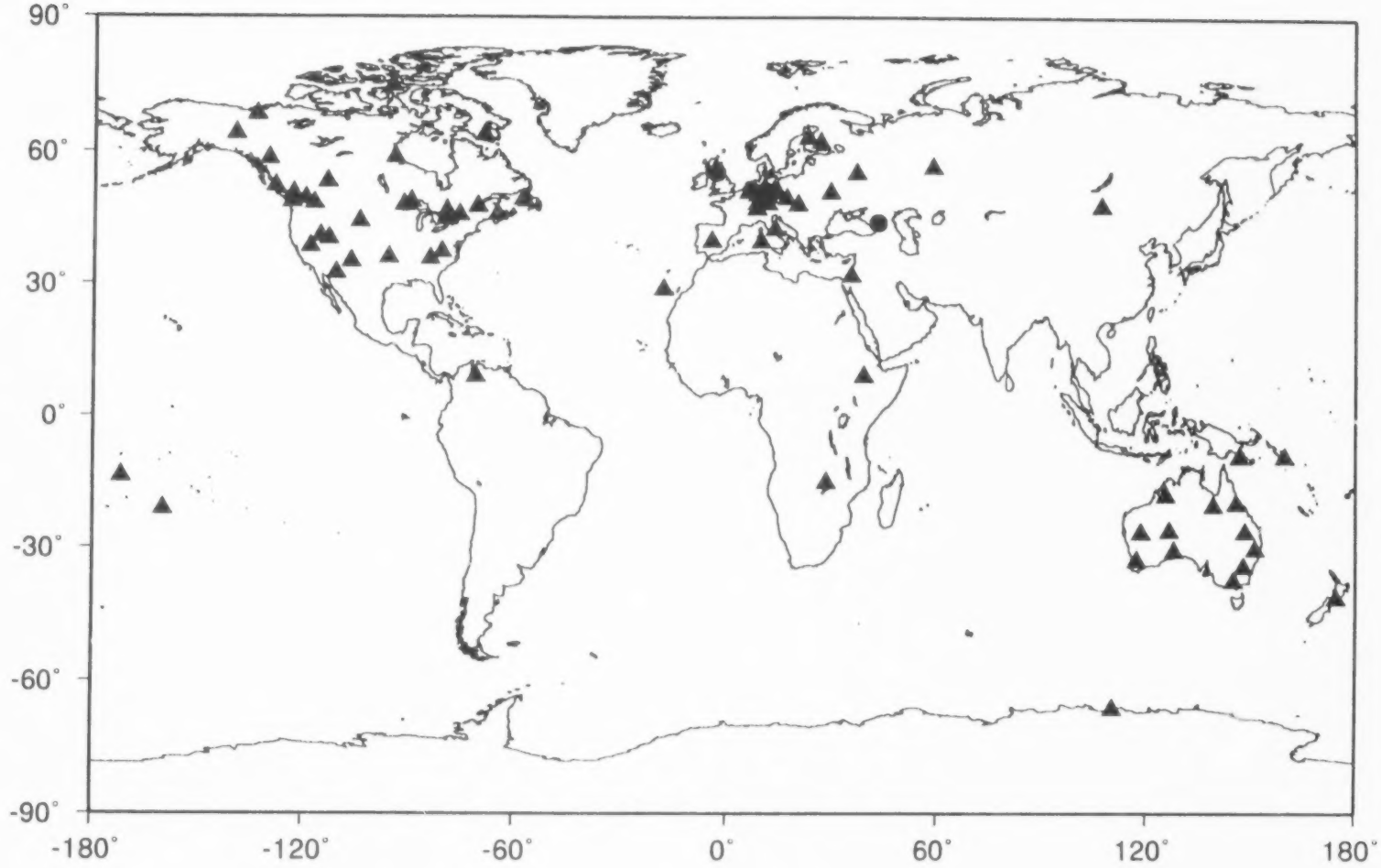

Fig. 2. Beta stations used by the IDC as of 18 August 1995. Arrays are shown as filled circles and three- and one-component stations as filled triangles.

Annex 3

Draft work programme for the next (42nd) session

1. Review of initial draft of a GSETT-3 evaluation report

2. Review of initial list of recommended auxiliary stations
3. Review of initial draft plan for the GSETT-3 to IMS transition

4. Discussion of future plans

5. Answer possible questions relating to GSETT-3 from the NTB Ad Hoc Committee or its Working Group on Verification

6. Submission of a progress report to the CD

7. Other matters